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EXPERIMENTAL FISHING TO DETERMINE DISTRIBUTION OF SALMON IN THE NORTH PACIFIC OCEAN, 1955

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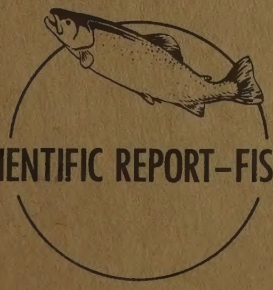

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UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

EXPLANATORY NOTE

The series embodies results of investigations, usually of restricted scope, intended to aid or direct management or utilization practices and as guides for administrative or legislative action. It is issued in limited quantities for official use of Federal, State or cooperating agencies and in processed form for economy and to avoid delay in publication.

United States Department of the Interior, Fred A. Seaton, Secretary
Fish and Wildlife Service

EXPERIMENTAL FISHING TO DETERMINE DISTRIBUTION OF SALMON IN THE NORTH PACIFIC OCEAN, 1955

By

Donald E. Powell
Fishery Methods and Equipment Specialist

and

Alvin E. Peterson
Fishery Research Biologist

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ABSTRACT

Distribution of salmon on the high seas in the North Pacific Ocean was investigated by the U. S. Fish and Wildlife Service during the summer and early fall of 1955. Three vessels conducted extensive gill-net operations over a 3-1/2 month period in the Gulf of Alaska and in the offshore waters south of the Aleutian Islands and the Alaska Peninsula, with a limited amount of fishing off the coasts of Oregon, Washington, and British Columbia. Results showed that the several species of North American salmon and the steelhead trout were widely distributed in the open ocean at that time of year and could be sampled readily with surface gill nets.

Salmon were caught at all stations occupied from off northern Vancouver Island across the Gulf of Alaska as far west as Unalaska Island. Catches farther west and in more southerly waters revealed an apparent southern limit for high-seas salmon at about 47° N. latitude in the area of major operation. South of this line in the warmer waters albacore replaced salmon in the gill-net catches.

Length measurements of all salmon were taken aboard the vessels and are presented graphically according to species and by mesh size.

CONTENTS

	Page
Introduction	1
Description of vessels	1
Gill-net construction and operation	1
Fishing results	10
John N. Cobb	10
Catch by species and mesh size	10
Depth of salmon	10
Vitality of gill-net-caught salmon	15
Seasonal composition of gill-net catches	15
Mitkof and Paragon	15
Catch composition	19
Water temperature	19
Length frequencies	24
Literature cited	24

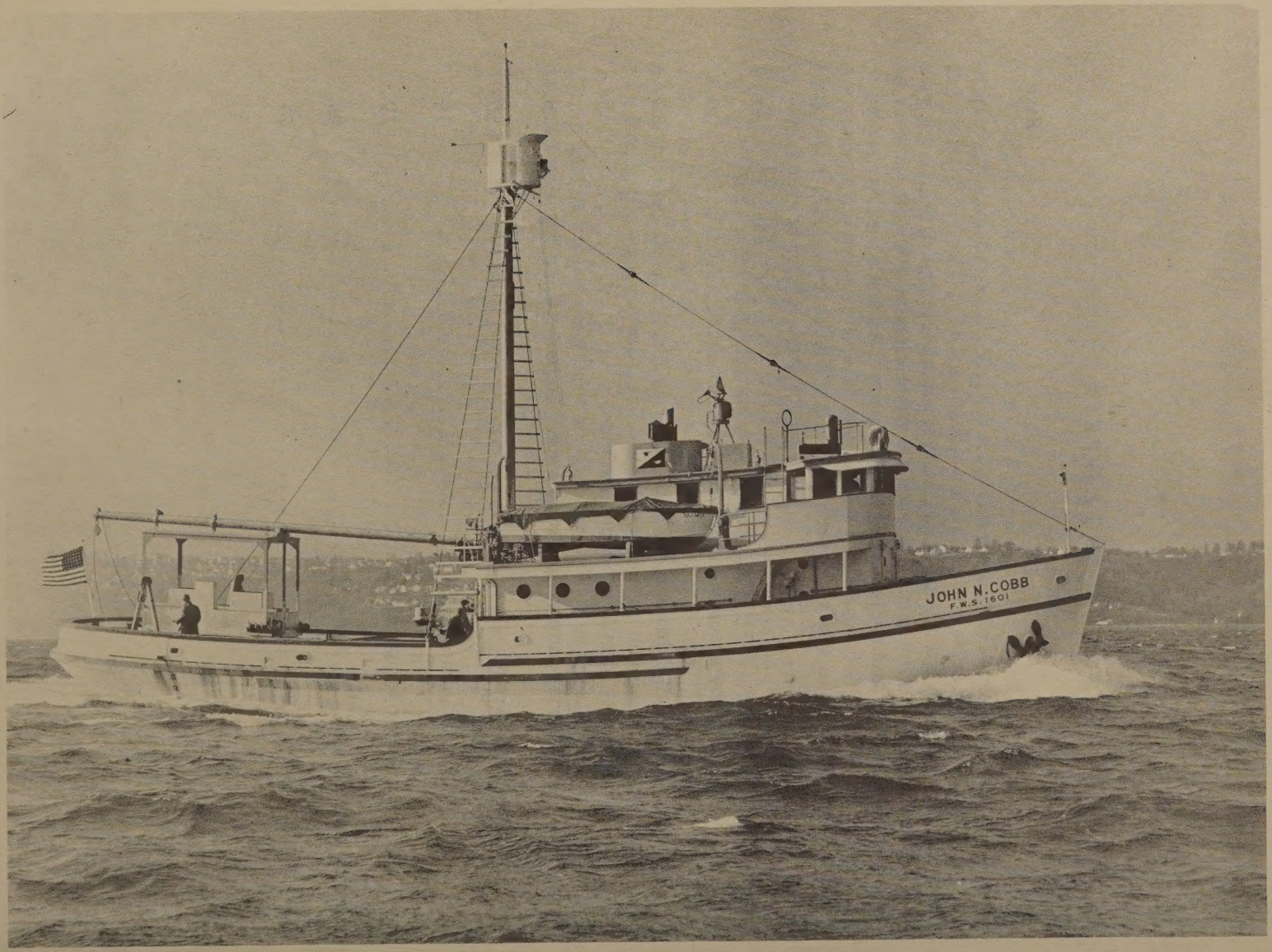


Figure 1.--The Fish and Wildlife Service's exploratory fishing vessel MV. John N. Cobb.

EXPERIMENTAL FISHING TO DETERMINE DISTRIBUTION OF SALMON IN THE NORTH PACIFIC OCEAN, 1955

INTRODUCTION

As a part of the research program requested by the International North Pacific Fisheries Commission, the U. S. Fish and Wildlife Service undertook in the summer and early fall of 1955 a broad study of the high-seas distribution of salmon in the North Pacific Ocean. Three vessels participated in this work, the Service's own research vessel John N. Cobb and the chartered halibut schooner-type vessels Mitkof and Paragon.

The aims of this investigation were to gain knowledge of the range and distribution of salmon in the eastern and central North Pacific Ocean and to collect samples of salmon throughout their range for morphological and physiological racial analysis. Oceanographic data were also collected simultaneously with the fishing operations for analysis by the Department of Oceanography, University of Washington. Ocean tagging on a minor scale was conducted by the Cobb only, with the main tagging program being carried out by the Fisheries Research Institute, University of Washington. The ultimate objective of all this work is to determine the extent of intermingling between Asian and North American stocks of salmon and to separate, if possible, the stocks of different continental origin in the high-seas fishing areas. Results are presented in preliminary form to make the data available until detailed biometric analysis now in progress, is completed.

DESCRIPTION OF VESSELS

Specifications for the exploratory fishing vessel John N. Cobb, 78 net tons, are as follows:

Length overall	93' 5-1/4"
Length, waterline	85' 0"
Beam over guards	25' 6-3/4"
Beam, molded	24' 6"
Depth, molded	12' 7"
Draft, molded (mean load)	8' 6"
Draft over keel (mean load)	9' 6"
Bunkers, Diesel fuel	12,000 gals.
Capacity, fresh water	6,000 gals.
Cruising speed	10 knots
Maximum speed	10.8 knots
Number of bunks	14

The two chartered schooner-type vessels were of the following specifications:

Vessel	MITKOF	PARAGON
Total length	72 feet	90 feet
Keel length	66' 1"	80 feet
Tonnage	42 tons	64 tons
Breadth	18' 4"	19' 5"
Draft	9'(empty)	9'(empty)
Cruising speed	9 knots	8.5 knots
Maximum speed	9.5 knots	9 knots
Engine & horsepower	Fairbanks, 200H.P.	Enterprise, 165H.P.
Number of bunks	12	13

GILL NET CONSTRUCTION AND OPERATION

The John N. Cobb fished with four sizes of nylon gill nets: 3-1/4-inch, 4-1/2-inch, 5-1/4-inch, and 6-inch stretched mesh measure. The nets were constructed to fish shallow (fig. 4) from the surface to about 20 feet deep. Past experience by the Cobb in 1953 (Schaefers and Fukuhara, 1954) and reports from the Japanese salmon fleet (Fukuhara, 1953) indicated that most salmon were caught close to the surface on the high seas.

The nets were made up in 50-fathom shackles, and on most sets either 20 shackles (1,000 fathoms) or 30 shackles (1,500 fathoms) were lashed together and fished in a string. A typical 20-shackle set was made up of two shackles of 3-1/4-inch mesh, five shackles of 4-1/2-inch mesh, 11 shackles of 5-1/4-inch mesh and two shackles of 6-inch mesh, arranged randomly. Lesser amounts of gear were used early in the season and during poor weather on several sets. A total of 1,018 shackles were fished during the trip: 126 shackles of 3-1/4-inch mesh, 249 shackles of 4-1/2-inch mesh, 565 shackles of 5-1/4-inch mesh, and 78 shackles of 6-inch mesh.

Figure 2.--Salmon charter vessel Mitkof.

Figure 3.--Salmon charter vessel Paragon.

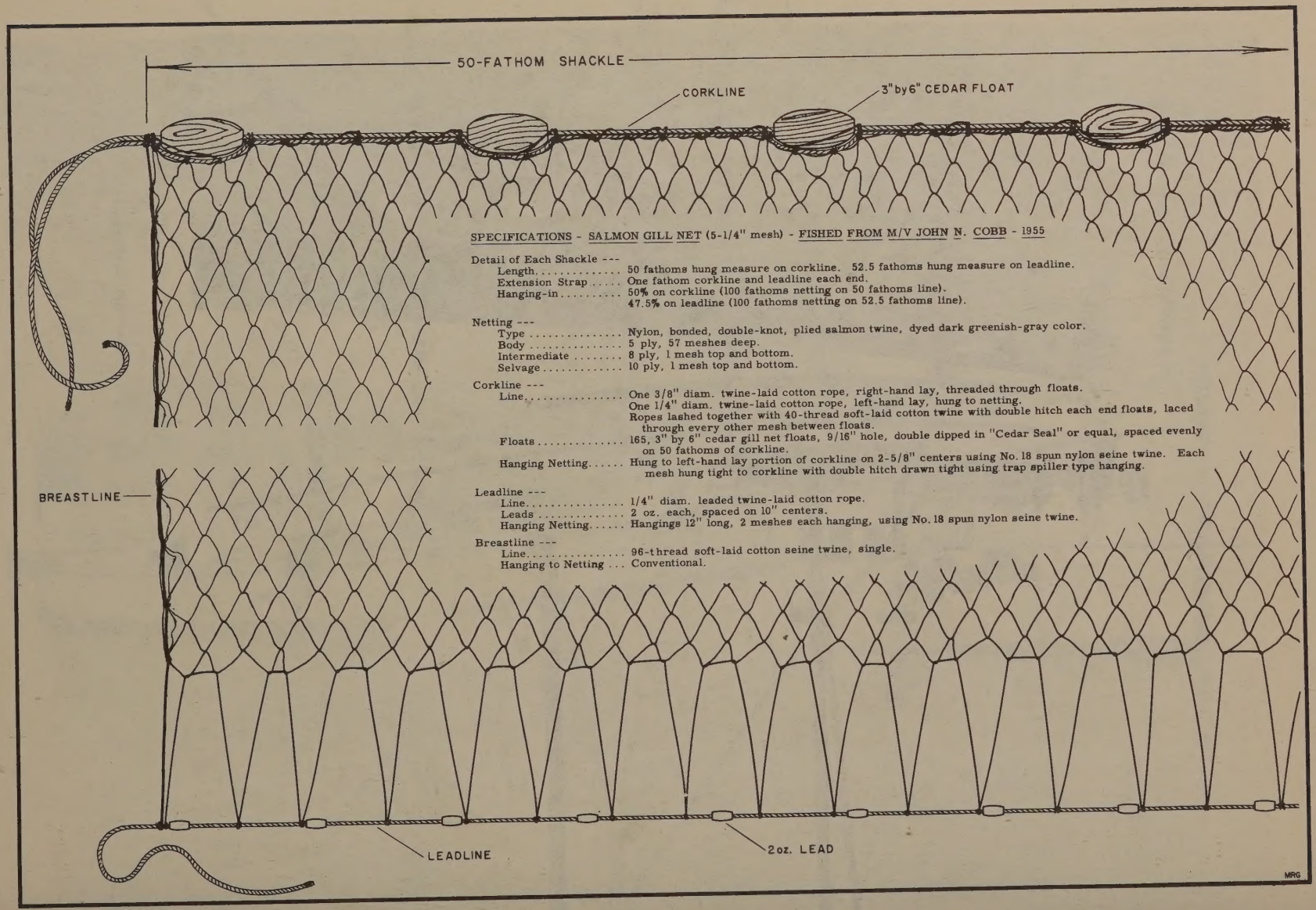

50-FATHOM SHACKLE
CORKLINE
3"by6" CEDAR FLOAT
SPECIFICATIONS - SALMON GILL NET (5-1/4" mesh) - FISHED FROM M/V JOHN N. COBB - 1955
Detail of Each Shackle ---
Length..... 50 fathoms hung measure on corkline. 52.5 fathoms hung measure on leadline.
Extension Strap ..... One fathom corkline and leadline each end.
Hanging-in..... 50% on corkline (100 fathoms netting on 50 fathoms line).
47.5% on leadline (100 fathoms netting on 52.5 fathoms line).
Netting ---
Type ..... Nylon, bonded, double-knot, plied salmon twine, dyed dark greenish-gray color.
Body ..... 5 ply, 57 meshes deep.
Intermediate ..... 8 ply, 1 mesh top and bottom.
Selvage ..... 10 ply, 1 mesh top and bottom.
Corkline ---
Line..... One 3/8" diam. twine-laid cotton rope, right-hand lay, threaded through floats.
One 1/4" diam. twine-laid cotton rope, left-hand lay, hung to netting.
Ropes lashed together with 40-thread soft-laid cotton twine with double hitch each end floats, laced through every other mesh between floats.
Floats..... 165, 3" by 6" cedar gill net floats, 9/16" hole, double dipped in "Cedar Seal" or equal, spaced evenly on 50 fathoms of corkline.
Hanging Netting..... Hung to left-hand lay portion of corkline on 2-5/8" centers using No. 18 spun nylon seine twine. Each mesh hung tight to corkline with double hitch drawn tight using trap spiller type hanging.
Leadline ---
Line..... 1/4" diam. leaded twine-laid cotton rope.
Leads ..... 2 oz. each, spaced on 10" centers.
Hanging Netting..... Hangings 12" long, 2 meshes each hanging, using No. 18 spun nylon seine twine.
Breastline ---
Line..... 96-thread soft-laid cotton seine twine, single.
Hanging to Netting ... Conventional.
BREASTLINE
LEADLINE
2oz. LEAD
MRG

Figure 4.--Diagram of salmon gill net fished from the John N. Cobb.

Double corklines, one right-hand lay and one left-hand lay to prevent twisting, were used on all gill nets. Each salvage mesh was lashed tightly to one corkline with a double hitch to minimize chafing of the salvage caused by wave action on the open ocean. Otherwise, the nets were hung essentially according to the conventional manner used in the salmon fishery. Details of the 5-1/4-inch nets are given in figure 4.

With the exception of three experimental daytime sets, the nets were fished at night, being set in the evening and hauled just after daybreak. The nets were set downwind over the stern of the boat at a speed of about 4 knots. A lighted flagpole was tied to each end of the string. Seven hundred feet of 4-1/4-inch circumference lubricated-core rope was attached with a bridle to the last shackle to go overboard, and was then made fast to the bow of the vessel at the lee end of the nets. The vessel thus held on to the gear all night while drifting.

Nylon rope, 15/16-inch diameter, was lashed along the corklines of the first eight shackles of nets nearest the vessel to relieve strain from the corklines while hauling. The gear was hauled over a shark roller mounted on the starboard rail near the bow of the John N. Cobb. Power for hauling was transmitted through a rubberized sheave attached to the main anchor winch. Fish were removed on a canvas-covered iron grating between the bow roller and the anchor winch. Two men then cleared the web and pulled it to the stern where it was piled in the bin in readiness for the next set.

Hauling time averaged about five minutes per shackle, increasing proportionately to the number of fish in the net. The occasional mackerel shark caused considerable gear damage and delay in hauling. Jack mackerel were extremely difficult to remove from the nets, but most of the pomfret could be shaken out with no trouble. The nets were mended daily on the John N. Cobb, and they were completely overhauled several times during the trip on brief port calls.

The Mitkof and the Paragon fished with four different mesh sizes of nylon gill nets, 2-1/4-inch, 3-1/4-inch, 4-1/2-inch, and 5-1/4-inch stretched mesh measure. Construction of the nets was the same as for the John N. Cobb, as shown in figure 4.

Twelve 50-fathom shackles of gill net were used for each set by the Mitkof and the Paragon, and the numbers of shackles of each mesh size used on every set were two shackles of 2-1/4-inch mesh, two shackles of 3-1/4-inch, two shackles of 4-1/2-inch and six shackles of 5-1/4-inch mesh. A standard arrangement of the various mesh sizes in the net was used for all sets, with the 5-1/4-inch mesh alternating with the smaller mesh sizes throughout the net.

In the fishing operations of both the Mitkof and the Paragon, nylon rope, 15/16-inch diameter, was lashed along the corklines for 1/4 to 1/2 of the net, and about 200 fathoms of manila line was fastened to the bridle from the vessel during the fishing. A flagpole with a light was tied to each end of the net during fishing, and the vessel remained attached to the net at all times. All sets by the Mitkof and Paragon were overnight sets.

The same system for setting and hauling the gill nets was used by both schooner-type vessels. The net was set from the stern of the vessel, paying out while the vessel proceeded ahead at slow speed for a period of 15 to 20 minutes (fig. 8). The net was set with the wind, so that when it was completely out, the vessel could remain secured to the lee end.

The net was hauled in from the starboard side of the vessel over a roller attached to the guard rail and over a table (where the fish were removed) by means of a mechanically driven "gurdy" (fig. 9). This operation took place in the well-deck forward of the pilot house, and from there the net was passed along the deck to the stern where it was re-piled in preparation for the next set. The hauling operation required up to two hours per set for both the Mitkof and the Paragon.

Upon completion of hauling, measurements and scale samples were taken from each salmon caught (fig. 11). On all three vessels a numbered metal strap tag was attached to the gill cover of each salmon for identification, and the fish were then frozen for further racial studies at the laboratory.

Figure 5.--Salmon were removed from the gill nets just aft of the roller on the bow of the John N. Cobb.

Figure 6.--After coming around the sheave on the anchor winch (to the left of the photo) the gill nets were cleared on their way to the stern of the John N. Cobb.

Figure 7.--The gill nets were piled in the stern bin of the John N. Cobb in preparation for the next set.

Figure 8.--Clearing gill nets during setting from the after-deck of the Mitkof.

Figure 9.--Hauling gill nets aboard the Mitkof.

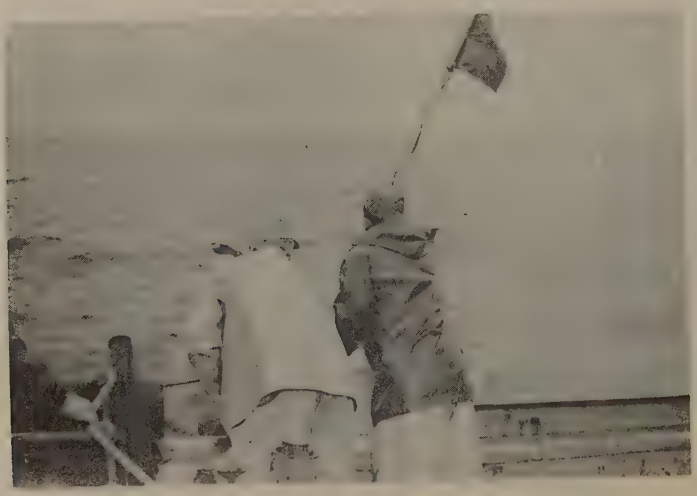


Figure 10.--Picking up marker buoy during hauling operations on the Mitkof.

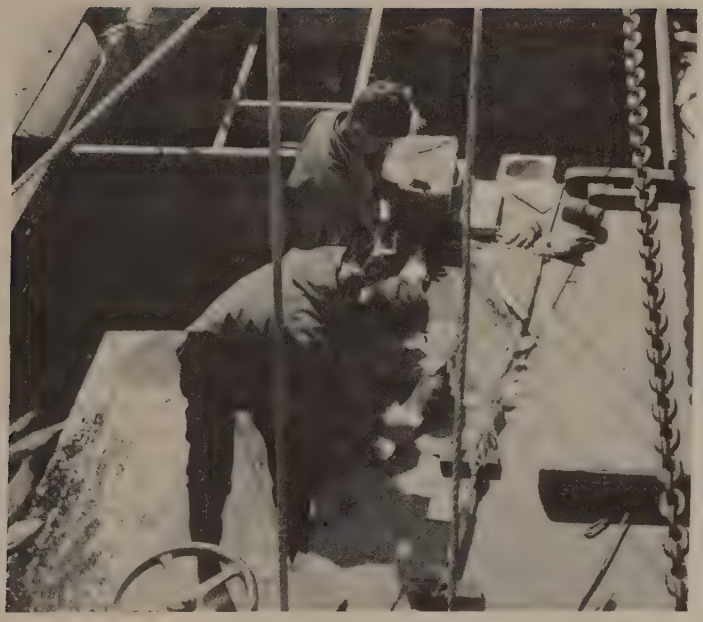


Figure 11.--Measuring and taking scales from salmon caught in gill nets on the Mitkof.

Figure 12.--Live salmon were placed in a small live box near the bow of the John N. Cobb, and those that survived were tagged and released.

FISHING RESULTS
John N. Cobb

Fifty gill-net stations were occupied by the John N. Cobb from June 25 to September 13 in the offshore waters extending from off northern Vancouver Island northward to southeastern Alaska and across the Gulf of Alaska as far west as Unalaska Island (fig. 13). Salmon were caught in the gill nets at each station, all five species being taken in a number of the sets.

Total gill-net catch of salmon for the 50 sets was 2,484, an average of 49 salmon per set. Individual catches ranged from 1 to 168 salmon. The catch included 1,248 chums, 639 pinks, 367 reds, 211 silvers, and 19 kings. Salmon-trolling gear fished in the vicinity of five gill-net stations caught 18 silvers, 3 pinks, and 1 king. In addition to salmon, the gill nets caught 55 steelhead trout and various numbers of pomfret, jack mackerel, dogfish, mackerel shark, and a few ragfish and squid. Tables 1 and 1a present the complete fishing log of the John N. Cobb, including dates, positions, catches by species, and other pertinent data.

Several stations in the Gulf of Alaska were fished a second time after an interval of about 2 months to compare catch results over a period of time. To compare effectiveness of the gill nets in day and night fishing, 3 sets were made in the daytime. The daytime sets each caught salmon, but the catch in each instance was less than the catches made in the same place at night.

Catch by species and mesh size

Chum salmon were most abundant in the gill-net catch of the John N. Cobb, comprising slightly over 50 percent of the total (table 2). Pinks were next most abundant, at 25.7 percent. Kings were least numerous, forming less than 1 percent of the catch. Species composition varied with dates and areas fished, as can be seen in the fishing log and in table 5. At no time were any jumpers or other surface signs of salmon seen in the offshore waters, and all gill-net sets were made "blind".

Table 2 also shows the catch by species for each of the four sizes of gill nets. The 4-1/2-inch mesh was most effective, catching 3.31 salmon per shackle. Next most effective mesh size was 5-1/4-inch, with an average catch of 2.45 per shackle. The 3-1/4-inch nets were least effective, 1.2 salmon per shackle, while the 6-inch nets were slightly higher at 1.58 salmon per shackle. Average catch for the 1,018 fifty-fathom shackles fished was 2.44 salmon per shackle.

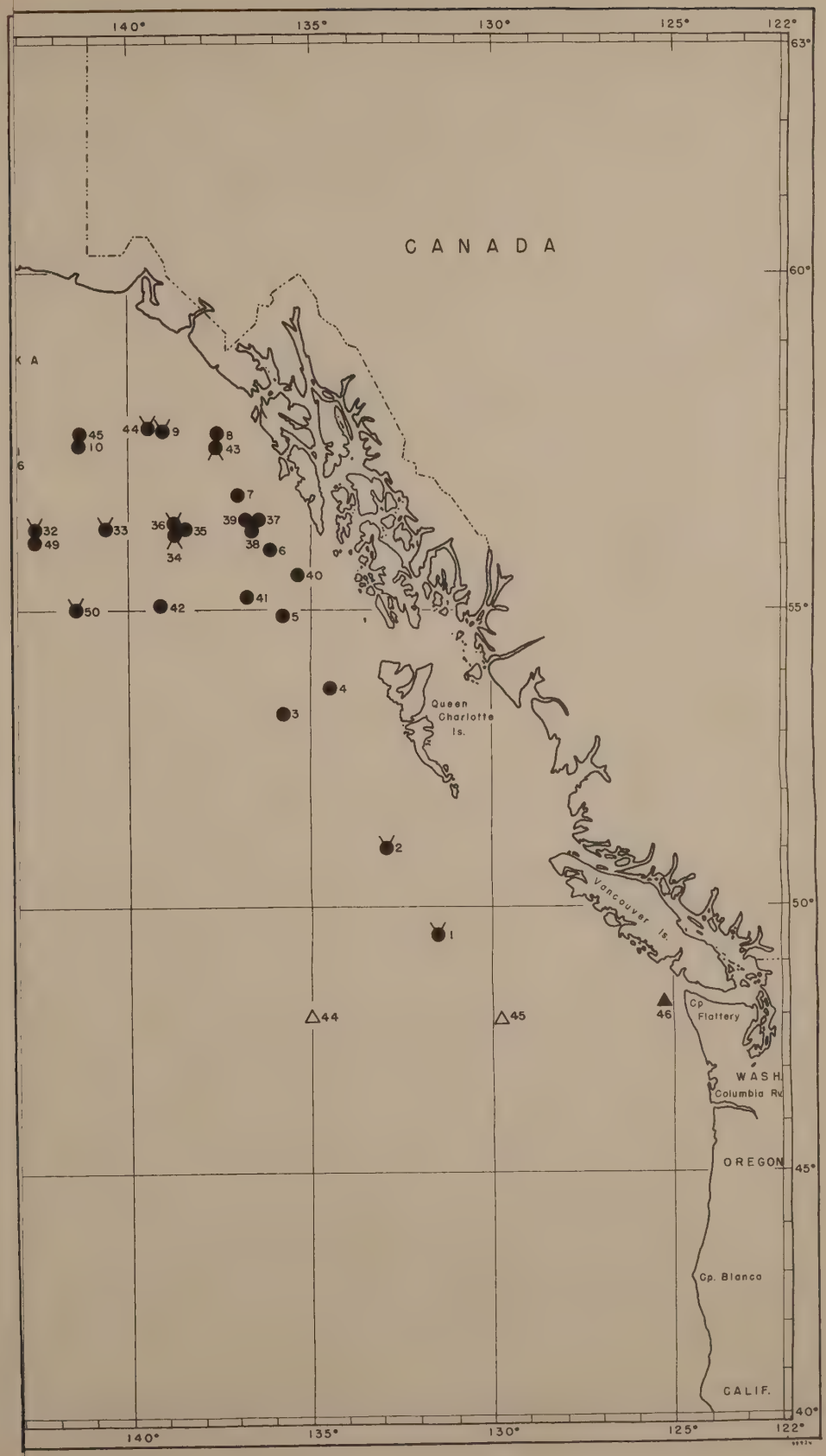
Each of the net sizes was selective to a degree in sizes of fish caught (fig. 16). This selection also affected the catch of some species for each mesh size. For instance, more reds and chums were taken in the smaller 3-1/4-inch nets than any of the other species, because small, immature individuals were more abundant in these two species than the others. Chums occurred most often in the 4-1/2-inch and 5-1/4-inch mesh. No small, immature pinks were caught. The number of kings taken was too small for significant comparison.

Depth of Salmon

A record was kept of the depth in the net at which the salmon were enmeshed (table 3). From these observations it is apparent that the salmon spend much of their time in the offshore waters very near the surface.

The nets were constructed to fish from the surface to a depth of approximately 20 feet. For purposes of recording depth of the salmon, the nets were arbitrarily divided into three parts, and the position of each salmon caught was recorded as in the "upper", "middle", or "lower" third of the net. In recording these data the observer merely made a quick judgment of the position of each fish as the net came near the vessel, as it approached the roller, or as the fish were being removed. Thus, there is some chance for error on those fish which were near the border lines of "upper", "middle", or "lower".

Table 3 shows that over half (53 percent) of the salmon caught by the John N. Cobb were recorded in the upper one-third of the nets, or within 7 feet of the surface. In the lower one-third there was a higher percentage of kings and reds than of the other 3 species, and conversely, kings and reds had lower percentages than the others in the upper part of the nets. The apparent



ically, and catch distribution.

Table 1 - Gill-net Catch Data --- M/V JOHN N. COBB --- Cruise 23 --- June 23 to September 18, 1955

Set No.	Date	Position of set Latitude N.	Longitude W.	No. hours net soaked 1/	Fathoms of net	Number of salmon caught: King	Red	Silver	Pink	Chum	Total salmon	Wind direction and force 2/	Surface temperature	Incidental catch
1	6/25 - 6/26	49°29'	131°29'	8¾	650	0	3	0	1	1	5	WNW-3	50.0°F.	1 steelhead
2	6/26 - 6/27	51°02'	132°52'	8½	650	0	6	1	1	1	9	SSE-4 - NNW-6	50.0°F.	1 steelhead
3	6/30 - 7/1	53°17'	135°42'	8	650	0	0	1	1	1	3	NW-4	49.0°F.	----
4	7/1 - 7/2	53°40'	134°26'	7	200	0	1	1	0	1	3	W-7	50.2°F.	----
5	7/2 - 7/3	54°55'	135°44'	11¼	650	0	7	1/4	5	15	41	NW-1	49.0°F.	1 steelhead
6	7/3 - 7/4	55°55'	136°08'	9¼	650	0	12	22	9	7	50	WNW-4	50.0°F.	1 mackerel shark, 3 dogfish
7	7/6 - 7/7	56°42'	136°53'	10¼	550	0	3	69	6	3	81	NNE-1 - NNE-2	52.0°F.	9 dogfish
8	7/7 - 7/8	57°40'	137°37'	11	650	0	1/4	6	6	7	33	0 - E-3	50.0°F.	12 dogfish
9	7/11 - 7/12	57°44'	139°09'	8¾	1000	0	32	17	29	47	125	SE-3	50.0°F.	1 steelhead, 2 mackerel shark
10	7/12 - 7/13	57°35'	141°21'	11	1000	0	13	6	32	35	86	0	51.5°F.	----
11	7/13 - 7/14	57°26'	143°26'	10½	1000	0	21	2	57	49	129	SW-3	51.0°F.	1 steelhead
12	7/14 - 7/15	57°18'	145°28'	8¾	400	0	2	1	4	1	8	SSE-5 - SSE-4	49.0°F.	2 steelhead
13	7/16	57°03'	148°19'	5¾	400	0	1	0	0	6	7	SW-4	48.3°F.	----
14	7/16 - 7/17	57°01'	149°32'	10½	1000	3	16	6	40	70	135	SSW-3 - SW-3	49.2°F.	2 steelhead
15	7/17 - 7/18	56°11'	151°07'	10½	1000	1	10	2	20	63	96	WSW-5 - SW-4	49.0°F.	2 steelhead, 1 mackerel shark
16	7/21 - 7/22	55°38'	152°37'	11	1000	0	8	6	10	10	34	WSW-4 - 0	54.0°F.	2 steelhead
17	7/22 - 7/23	54°30'	152°49'	9¾	1000	1	6	2	7	16	32	SW-4 - SW-5	52.5°F.	4 steelhead
18	7/23 - 7/24	53°26'	152°36'	10½	1000	1	9	2	9	9	30	SSW-3 - S-3	51.0°F.	4 steelhead, 1 mackerel shark
19	7/24 - 7/25	53°38'	154°44'	8½	1000	2	5	0	6	6	19	SW-4 - SE-4	50.0°F.	2 steelhead
20	7/25 - 7/26	53°47'	156°23'	9½	1000	0	22	2	7	18	49	W-4 - SE-7	50.2°F.	1 mackerel shark
21	7/26 - 7/27	53°28'	158°45'	6¾	1000	0	7	0	0	1	8	S-4 - SXW-8	50.0°F.	2 steelhead
22	7/29 - 7/30	53°12'	161°49'	9½	1000	0	20	1	2	9	32	W-3 - 0	49.5°F.	4 steelhead
23	7/30 - 7/31	52°39'	163°12'	10½	1000	0	6	5	2	3	16	WSW-4	51.0°F.	1 steelhead
24	7/31 - 8/1	52°14'	165°21'	8½	1000	0	18	0	0	14	32	W-5 - WSW-3	49.8°F.	----
25	8/1 - 8/2	53°20'	165°27'	8¾	1000	2	50	2	8	11	73	N-2 - S-2	50.5°F.	----
26	8/4 - 8/5	53°43'	160°35'	11	1000	1	21	4	0	69	95	NW-4 - NW-6	53.0°F.	8 steelhead
27	8/5 - 8/6	54°10'	158°14'	9	400	0	11	0	2	1	14	W-6	53.0°F.	----
28	8/9 - 8/10	57°23'	150°09'	7¾	1500	4	4	25	32	84	149	NNE-4 - N-4	52.5°F.	2 mackerel shark, 1 dogfish
29	8/10 - 8/11	56°29'	148°49'	9¼	1500	0	13	3	7	54	77	W-4 - SSW-4	53.5°F.	1 steelhead, 2 mackerel shark, 8 jack mackerel
30	8/11 - 8/12	56°29'	146°22'	8¼	400	0	1	0	0	0	1	SXW-5 - S-6	52.5°F.	----
31	8/16 - 8/17	56°07'	144°17'	5¾	1150	0	2	1	1	10	14	SW-2 - NWXW-1	53.0°F.	1 steelhead, 1 mackerel shark, 32 jack mackerel, 3 pomfret
32	8/17 - 8/18	56°13'	142°30'	11¼	1500	0	12	0	10	19	41	0 - SXW-3	52.5°F.	2 steelhead, 30 jack mackerel, 46 pomfret
33	8/18 - 8/19	56°16'	140°35'	9¼	1500	0	0	2	16	37	55	SW-5 - SW-4	52.0°F.	1 steelhead, 14 jack mackerel, 110 pomfret
34	8/19 - 8/20	56°17'	138°39'	8¾	1500	1	3	1	37	87	129	SWXS-4	53.5°F.	2 steelhead, 14 jack mackerel, 31 pomfret

Footnotes on next page.

Table 1 - Gill-net Catch Data --- M/V JOHN N. COBB --- Cruise 23 --- June 23 to September 18, 1955 (Continued)

Set No.	Date	Position of set Latitude N.	Longitude W.	No. hours net soaked 1/	Fathoms of net	Number of salmon caught King	Red	Silver	Pink	Chum	Total salmon	Wind direction and force 2/	Surface temperature	Incidental catch
35 3/	8/20	56°18'	138°37'	6½	1500	0	1	0	11	11	23	SWXS-4 - SW-3	54.0°F.	1 jack mackerel
36	8/20 - 8/21	56°19'	138°42'	10¼	1500	0	0	1	28	16	45	SW-3 - SW-2	54.0°F.	1 steelhead, 54 jack mackerel, 28 pomfret
37	8/21 - 8/22	56°18'	136°39'	8⅝	1500	0	2	0	138	28	168	WSW-4 - W-4	53.5°F.	1 mackerel shark, 43 pomfret, 2 brown ragfish
38 3/	8/22	56°18'	136°45'	6¼	1500	0	0	0	5	4	9	W-4	54.0°F.	----
39	8/22 - 8/23	56°20'	136°48'	8½	1500	0	0	1	72	11	84	SW-2 - W-3	53.0°F.	3 mackerel shark, 20 pomfret, 2 brown ragfish
40	8/26 - 8/27	55°30'	135°16'	8½	1500	0	0	1	13	8	22	W-4 - W-5	53.5°F.	17 pomfret
41	8/28 - 8/29	55°11'	136°52'	8¼	1500	0	0	0	1	46	47	SW-2 - WSW-3	53.5°F.	2 mackerel shark, 25 jack mackerel, 56 pomfret, 1 brown ragfish
42	8/29 - 8/30	55°01'	139°17'	8¼	1500	0	0	0	0	36	36	SW-3 - SW-1	53.0°F.	1 mackerel shark, 36 jack mackerel, 11 pomfret, 2 squid
43	9/5 - 9/6	57°39'	137°37'	10¼	1000	0	0	0	4	11	15	W-3 - NNW-4	53.0°F.	1 steelhead
44	9/6 - 9/7	57°46'	139°23'	10⅜	1000	0	0	1	0	146	147	NW-5	52.0°F.	3 steelhead
45	9/7 - 9/8	57°36'	141°22'	9	1000	3	0	0	0	75	78	WSW-4 - WSW-5	51.0°F.	1 mackerel shark, 3 pomfret
46	9/8 - 9/9	57°25'	143°26'	10¼	1000	0	0	2	0	35	37	SSW-4 - SSW-2	50.0°F.	2 steelhead, 8 jack mackerel, 3 pomfret
47	9/9 - 9/10	57°16'	145°30'	11	1000	0	0	1	0	15	16	SE-5 - SSE-5	50.5°F.	2 steelhead, 3 jack mackerel
48 3/	9/10	57°17'	145°28'	7⅜	1000	0	2	0	0	5	7	SE-6	50.0°F.	----
49	9/11 - 9/12	56°00'	142°43'	8⅜	1000	0	3	0	0	12	15	SE-5 - SE-4	50.5°F.	2 pomfret
50	9/12 - 9/13	55°01'	141°25'	9⅜	1000	0	0	0	0	24	24	SSE-3 - NW-6	50.5°F.	1 steelhead, 1 jack mackerel, 5 pomfret
TOTALS				459	50,900	19	367	211	639	1248	2484			55 steelhd., 19 m. shark, 226 jack m., 378 pomfret, 32 misc.

Table 1a - Troll Catch Data --- M/V JOHN N. COBB --- Cruise 23 --- June 23 to September 18, 1955

Set No.	Date	Position 4/ Latitude N.	Longitude W.	No. hours fished	No. lures fished	Depth fished (fathoms)	Number salmon caught King	Silver	Pink	Total salmon	Wind direction and force 2/	Surface temperature	Incidental catch
1	6/25	49°29'	131°42'	6¼	17	4 - 76	0	0	0	0	NW-4	52° - 53°F.	---
2	6/30	52°57'	135°39'	7½	18	4 - 61	0	0	0	0	NW-4	50°F.	---
3	7/1	53°20'	135°27'	5	20	4 - 35	1	4	0	5	WNW-5	49°F.	8 rockfish
4	7/2	54°51'	135°42'	4¼	18	4 - 25	0	12	2	14	WNW-3	48.5°F.	---
5	7/3	55°55'	136°09'	2¼	20	4 - 25	0	1	0	1	W-5	52.0°F.	---
6	7/6	56 48'	137 03'	3¾	20	4 - 22	0	1	1	2	NNE-3	50.0 F.	---
TOTALS				29			1	18	3	22			8 rockfish

1/ Does not include setting and hauling time.

2/ Wind force according to Beaufort scale.

3/ Daytime set.

4/ Position given taken at start of trolling when possible, otherwise at end.

Table 2.--Catch of salmon by species and mesh size(50 gill-net sets), John N. Cobb.

Species of salmon	Total number caught	Percent of total catch	3¼-inch mesh 126 shackles		4½-inch mesh 249 shackles		5¼-inch mesh 565 shackles		6-inch mesh 78 shackles		Total of 1,018 shackles fished
			Number salmon caught	Catch per shackle	Number salmon caught	Catch per shackle	Number salmon caught	Catch per shackle	Number salmon caught	Catch per shackle	Average catch per shackle
King	19	.8	0	0	6	.02	11	.02	2	.03	.02
Red	367	14.8	68	.54	155	.62	126	.22	18	.23	.36
Silver	211	8.5	6	.05	91	.37	101	.18	13	.17	.21
Pink	639	25.7	3	.02	214	.86	390	.69	32	.41	.63
Chum	1248	50.2	74	.59	359	1.44	757	1.34	58	.74	1.22
Totals	2484	100	151	1.20	825	3.31	1385	2.45	123	1.58	2.44

Table 3.--Depth at which salmon entered the gill nets, John N. Cobb

Species of salmon	Number of salmon observed 1/	Number and percent in each portion of net					
		Upper 1/3 meshes		Middle 1/3 meshes		Lower 1/3 meshes	
		Number	Percent	Number	Percent	Number	Percent
King	19	8	42	5	26	6	32
Red	318	126	40	70	22	122	38
Silver	193	113	59	30	15	50	26
Pink	596	348	58	126	21	122	21
Chum	1189	632	53	262	22	295	25
Totals	2315	1227	53	493	21	595	26

1/ For various reasons, the above data were not recorded for 169 salmon in the total catch of 2,484.

Table 4.--Vitality of gill-net-caught salmon and number tagged, John N. Cobb

Species of salmon	Numbers observed 1/	Dead		Alive		Tagged 2/	
		Number	Percent	Number	Percent	Number	Percent
King	19	15	79	4	21	3	16
Red	367	211	57	156	43	72	20
Silver	205	156	76	49	24	36	18
Pink	635	507	80	128	20	66	10
Chum	1243	1010	81	233	19	134	11
Totals	2469	1899	77	570	23	311	13

1/ Vitality of 15 salmon in the total catch was not recorded.

2/ Only those live salmon which remained active in a live box for several minutes after capture were tagged. Many died shortly after being removed from the net. In addition to the 72 red salmon tagged, an additional 45 live reds, which could have been tagged, were saved for blood samples.

small advantage of the lower one-third over the middle one-third of the nets could be due to observational error and probably should not be considered significant.

Vitality of gill-net caught salmon

Most of the salmon caught in the gill nets were dead when landed. Condition of the fish was directly related to the state of the sea. In rough weather many salmon had most of their scales removed by the chafing action of the nets, and the increased strain on the gear caused the nylon meshes to grip the fish more tightly, resulting in cuts and abrasions of the skin and flesh and often making it necessary to cut the mesh in order to release the fish without further damage.

From table 4 it may be seen that 77 percent of the salmon caught by the John N. Cobb were dead when landed. The percentage of reds alive was about twice that for any other species (43 percent as compared to the average of 23 percent). The reason for this apparent greater tenacity of life of the red salmon was not clear. They may struggle less in the nets; this was indicated by the observation that the reds in general were less de-scaled than the other species. Swimming habits might be responsible, if, for some reason, the reds entered the nets more often in the early morning just before the gear was hauled.

Of the total 23 percent of live gill-net-caught salmon 13 percent, or 311 fish, were tagged and released after being held for a while in a live box. Many others died shortly after being removed from the net. In addition to the 72 red salmon tagged, 45 live reds which could have been tagged were saved for blood samples. Seventeen silvers and two pinks caught trolling were tagged and released. The small number of tag returns from the gill-net-caught fish (3 returns reported to March 1956) is insufficient for any good indication of the number of tagged fish which survived.

Seasonal composition of gill-net catches

Table 5 presents information on the composition of the John N. Cobb's salmon catches during the several months of operation. The fishing effort was concentrated during July and August, and these two months produced the bulk of the catch. During July the catch per shackle was greatest. It should be remembered that the vessel moved over a wide area and that the species composition was undoubtedly affected by area fished in addition to time of fishing.

Reds were dominant in the small catch made during June, composing 53 percent of the total. Pinks and chums increased in July and August, and by September chums made up 95 percent of the catch. In July and early August when the catch of red salmon was highest, the fishing was mainly in the western Gulf and south of the Alaska Peninsula out to Dutch Harbor. The large catches of pinks and chums in late August and September were made in the eastern half of the Gulf of Alaska.

Three positions were fished a second time after a 2-month interval with identical amounts of gill nets. These stations were in the eastern Gulf of Alaska, on a line between Cape Spencer and Kodiak. They were fished first in early July (sets 9-11) and again in early September (sets 44-46), with good catches each time. Red and pink salmon, which were caught in fair numbers at each of these stations in July, disappeared entirely from the catches made in September. Almost the entire catch at all three stations in September was chum salmon. At two of the three stations the chum catch was greater in September than in July.

Mitkof and Paragon

The Mitkof and Paragon operated mainly in the offshore waters south of the Aleutian Islands and Alaska Peninsula, with 26 gill-net stations by the Mitkof and 26 stations by the Paragon being completed, as shown in figure 13 and tables 6 and 7. The westernmost stations south of the outer Aleutian Island chain between 175° E. longitude and 175° W. longitude were fished by the Paragon, with one additional station being taken on the homeward trip to Seattle at station number 37 south of the central Gulf of Alaska. The Mitkof series of stations, east of, but overlapping, the rectangular fishing area of the Paragon, ranged from 175° W. longitude to

Table 5.--Species breakdown of salmon gill-net catches by month--June - September 1955, John N. Cobb

Month	Total number of salmon	Catch per shackle	Number and percent for each month's catch									
			King		Red		Silver		Pink		Chum	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
June	17	0.44	0	0	9	53	2	11	3	18	3	18
July	1,046	2.99	8	1	233	22	164	16	251	24	390	37
August	1,082	2.31	8	1	120	11	41	4	381	35	532	49
September	339	2.12	3	1	5	2	4	1	4	1	323	95
Totals	2,484	2.44	19	1	367	15	211	8	639	26	1,248	50

Table 6 - Gill-net Catch Data --- M.V. MITKOF --- August 11 to October 5, 1955

Station No.	Date	Position of set Latitude N.	Longitude W.	No. hours net soaked 1/	Surface temperature	Number of salmon caught					Salmon catch by mesh size				Incidental catch					
						Red	Chum	Silver	King	Total	5½"	4½"	3½"	2½"	Steelhead	Albacore	Blue shark	Pomfret	Other fish	Squid
1	8/11 - 8/12	52°02'	164°43'	16	49.6°F.	22	31			53	24	18	11							2
2	8/12 - 8/13	51°06'	164°42'	13½	50.2°F.	41	16			57	18	22	17					4		6
3	8/13 - 8/14	50°00'	165°25'	14	51.8°F.	3	16			19	5	9	5					2		10
4	8/14 - 8/15	49°00'	165°07'	16	52.9°F.	1	2			3	1		2					5	3 Giant skilfish	3
5	8/15 - 8/16	48°00'	164°55'	13⅝	56.5°F.												5			
6	8/16 - 8/17	47°00'	165°00'	15¼	59.4°F.											3	5	12		
7	8/17 - 8/18	46°00'	164°57'	16	60.4°F.												15	5		3
8	8/18 - 8/19	44°59'	165°17'	14⅓	62.3°F.											3	4	59		14
9	8/19 - 8/20	45°00'	167°35'	11¼	61.8°F.											21	66	4	13 Squaretail	59
10	8/20 - 8/21	44°50'	170°03'	12½	61.8°F.											18	21	1	6 Squaretail	69
11	8/21 - 8/22	45°58'	169°56'	18⅚	60.9°F.											4	14			1
12	8/22 - 8/23	46°54'	169°52'	16½	59.9°F.											2	9	3		13
13	8/23 - 8/24	47°56'	170°07'	16½	60.4°F.											1	3			1
14	8/24 - 8/25	49°03'	170°13'	15⅛	53.6°F.															
15	8/25 - 8/26	50°00'	170°08'	15	54.3°F.	5	3			8	3	4	1						4 Giant skilfish	
17	9/2 - 9/3	50°00'	175°00'	18¼	50.4°F.	22	7		1	30	14	10	6		1			5	1 Giant skilfish	2
18	9/3 - 9/4	49°00'	175°06'	15	51.5°F.	4	1			5		3	2					2		1
19 2/	9/4 - 9/7	48°00'	175°00'	65	51.4°F.	4	12			16	13	3							7 Giant skilfish, 1 Mackerel shark	
39	9/21 - 9/22	51°03'	154°35'	21½	50.1°F.	10	2		1	13	5	2	6		4			1		2
40	9/22 - 9/23	50°05'	154°42'	12	50.0°F.	10	2	1		13	5	1	7					9		3
41	9/23 - 9/24	49°02'	154°42'	14¼	51.7°F.													8		
42	9/24 - 9/25	47°57'	155°00'	11½	52.7°F.												2	17		5
43	9/27 - 9/28	47°57'	144°52'	23	55.3°F.											1	30	2	1 Giant skilfish, 2 Jack mackerel	1
44	9/30 - 10/1	47°57'	135°00'	22	56.7°F.												20			
45	10/2 - 10/3	47°56'	129°52'	21	57.5°F.												18		4 Giant skilfish	
46	10/4 - 10/5	48°08'	125°27'	7	50.2°F.		2	12	1	15	14	1					2		25 Dogfish, 24 Jack mackerel, 1 Race	
TOTALS						122	94	13	3	232	102	73	57		5	53	244	139		195

1/ Does not include setting and hauling time

2/ Caught in storm and drifted 43 miles NE from station

Note: 600 fathoms of net fished on all stations

99924

Table 7 - Gill-net Catch Data --- M.V. PARAGON --- August 12 to October 5, 1955

Station No.	Date	Position of set Latitude N.	Longitude	No. hours net soaked 1/	Surface temperature	Number of salmon caught					Salmon catch by mesh size				Incidental catch					
						Red	Chum	Silver	King	Total	5½"	4½"	3½"	2½"	Steelhead	Albacore	Blue shark	Pomfret	Other fish	Squid
1	8/12 - 8/13	50°00'	175°00' W.	20	52.7°F.	30	11	1	11	53	17	12	20	4				4	1 Handsaw	Present
2	8/13 - 8/14	49°00'	175°00' W.	16⅛	54.9°F.	2	15			17	8	5	4					29		"
3	8/14 - 8/15	48°00'	175°00' W.	15	56.8°F.	3	8			11	8	1	2		1			112	1 Opah, 1 Mackerel shark	
4	8/15 - 8/16	47°00'	175°00' W.	16¼	59.7°F.											8	27	24		
5	8/16 - 8/17	46°00'	175°00' W.	16	60.3°F.											48	23	3		
6	8/17 - 8/18	45°00'	175°00' W.	11½	61.1°F.											18	9	1		
7	8/18 - 8/19	45°00'	177°30' W.	10⅜	63.5°F.											87				Present
8	8/19 - 8/20	45°00'	180°00'	10	63.7°F.											1	2			"
9	8/20 - 8/21	45°00'	177°30' E.	11¾	66.4°F.													1	3	127 Squaretail, 1 Mackerel shark	"
10	8/21 - 8/22	45°00'	175°00' E.	8⅜	64.6°F.													1	4		"
11	8/22 - 8/23	46°03'	175°25' E.	11½	61.5°F.													9	1		"
12	8/23 - 8/24	47°00'	175°00' E.	13½	58.3°F.											1	9		1 Mackerel shark	"
13	8/24 - 8/25	48°00'	175°00' E.	16¼	57.6°F.															"
14	8/25 - 8/26	49°00'	175°00' E.	16½	54.9°F.														2		
15	8/26 - 8/27	50°00'	175°00' E.	11¾	51.4°F.	1	33			34	27	5	2						9		Present
16	8/27 - 8/28	50°00'	177°30' E.	12¼	51.3°F.	11	59			70	29	29	12						121	1 Mackerel shark	
17	9/2 - 9/3	50°00'	180°00'	11½	50.5°F.	16	111			127	69	36	22						2	1 Mackerel shark	Present
18	9/3 - 9/4	49°00'	180°00'	17⅛	50.5°F.	6	91			97	61	29	7		1				2	2 Giant skilfish	"
19	9/4 - 9/7	48°00'	180°00'	62¾	52.2°F.	Nets torn loose in heavy seas - No catch														
29	9/12 - 9/13	50°00'	175°00' E.	11⅛	48.4°F.	4	33			37	35			2					1		
28	9/13 - 9/14	49°00'	174°55' E.	15	50.0°F.		47			47	44		3						4		Present
27	9/14 - 9/15	47°38'	174°49' E.	16¼	52.7°F.		3			3	3								4		"
26	9/15 - 9/16	47°00'	175°00' E.	15¼	53.6°F.		13			13	13					1	2		16	1 Mackerel shark	
35	9/16 - 9/17	47°00'	177°30' E.	8¾	52.4°F.		2			2	2								4		Present
36	9/18 - 9/19	48°00'	177°30' W.	11⅝	50.2°F.		30			30	28		2						5		"
33	9/20	50°00'	175°00' W.	7¾	49.1°F.	3	14			17	14	1	2								
37	10/1 - 10/3	51°00'	145°00' W.	45½	52.3°F.										1				2	1 Jack mackerel	Present
38	10/4 - 10/5	50°00'	145°00' W.		49.8°F.	Nets lost after two days - No catch														
TOTALS						76	470	1	11	558	358	118	76	6	3	157	82	353		

1/ Does not include setting and hauling time

Note: 600 fathoms of net fished on all stations

south of the western Gulf of Alaska, with 4 additional stations being fished along the 48° N. latitude line on the homeward journey. The fishing period for these two vessels extended from August 11, 1955 to October 5, 1955.

Catch composition

The total salmon catch for the 11 stations where salmon were caught by the Mitkof was 232, an average of 21 salmon per set for 12 shackles of gill net. Individual catches ranged from 3 to 57 salmon. The seasonal catches by species were 122 reds, 94 chums, 13 silvers and 3 kings. No pinks were taken. Five steelhead were caught. The complete fishing log of the Mitkof showing the catches of salmon and other species of fish as well as other pertinent data is given in table 6.

The total salmon catch by the Paragon for the 14 stations where salmon were netted was 558, an average of 40 salmon per set. The catch per set ranged from 2 to 127 salmon. In all, 76 reds, 470 chums, 1 silver and 11 kings were taken. As with the Mitkof, no pinks were caught. Three steelhead were taken. The complete fishing log for the Paragon is given in table 7.

Chum salmon and red salmon formed the bulk of the salmon catches by the Mitkof and Paragon, as is demonstrated in tables 8 and 9. The Mitkof caught 52.6 percent reds, 40.5 percent chums, 5.6 percent silvers, 1.3 percent kings and no pinks. The Paragon caught 84.2 percent chums, 13.6 percent reds, 2 percent kings, 0.2 percent silvers and no pinks.

Tables 10 and 11 show the salmon catch by species for each of the mesh sizes fished both in total numbers and on a catch-per-shackle basis. The 4-1/2-inch mesh was the most effective on the Mitkof, taking 3.32 salmon per shackle. On the Paragon the two most effective nets were the 4-1/2-inch mesh (4.21 salmon per shackle) and the 5-1/4-inch mesh (4.28 salmon per shackle). In the catch of all three vessels the 4-1/2-inch mesh was the most effective for taking salmon.

Water temperature

Whereas the John N. Cobb fished throughout the Gulf of Alaska in waters where salmon were present at every station, the Mitkof and Paragon deliberately fished in more southerly waters in and out of the warm Japanese current to determine the southern range of the salmon. Hence, salmon were taken only on the more northerly stations by the latter two vessels.

On the more southerly stations, while salmon were not present, numbers of albacore were taken. A total of 210 albacore at 15 stations between 45° N. latitude and 48° N. latitude were taken by the two vessels. Also, blue sharks were usually caught along with albacore.

The relation of surface water temperature to numbers of salmon and albacore caught by the two vessels is demonstrated in figure 14. The extreme range of water temperatures where salmon were caught was from 48.4° F. to 56.8° F. On the other hand, water temperatures ranged from 53.6° F. to 63.7° F. where albacore were taken. Salmon and albacore were taken in the same net haul only once--at station 26 of the Paragon. The general trend shown in figure 14 is U-shaped, with the greater catches of salmon occurring in the colder waters, small catches or no catches of salmon and albacore at intermediate temperatures, and the greater catches of albacore in the warmer waters.

The surface water temperatures at the 50 John N. Cobb fishing stations ranged from 48.3° F. to 54.0° F. with salmon taken at all stations and no albacore taken at any station.

A series of sets (stations 12-14) by the Paragon along the 175° E. longitude line made between August 24 and August 26, 1955 was repeated in mid-September (stations 26-28) when the water temperature had cooled 4.7° F. to 4.9° F. at each station. On the initial run no salmon were taken, but on the later run salmon were caught at all three stations. This phenomenon indicates that the salmon tend to increase their geographic range in a southerly direction as the warm Japanese current is restricted southward.

After the main fishing cruises of the Mitkof and Paragon were completed, a short additional cruise was made south along the North

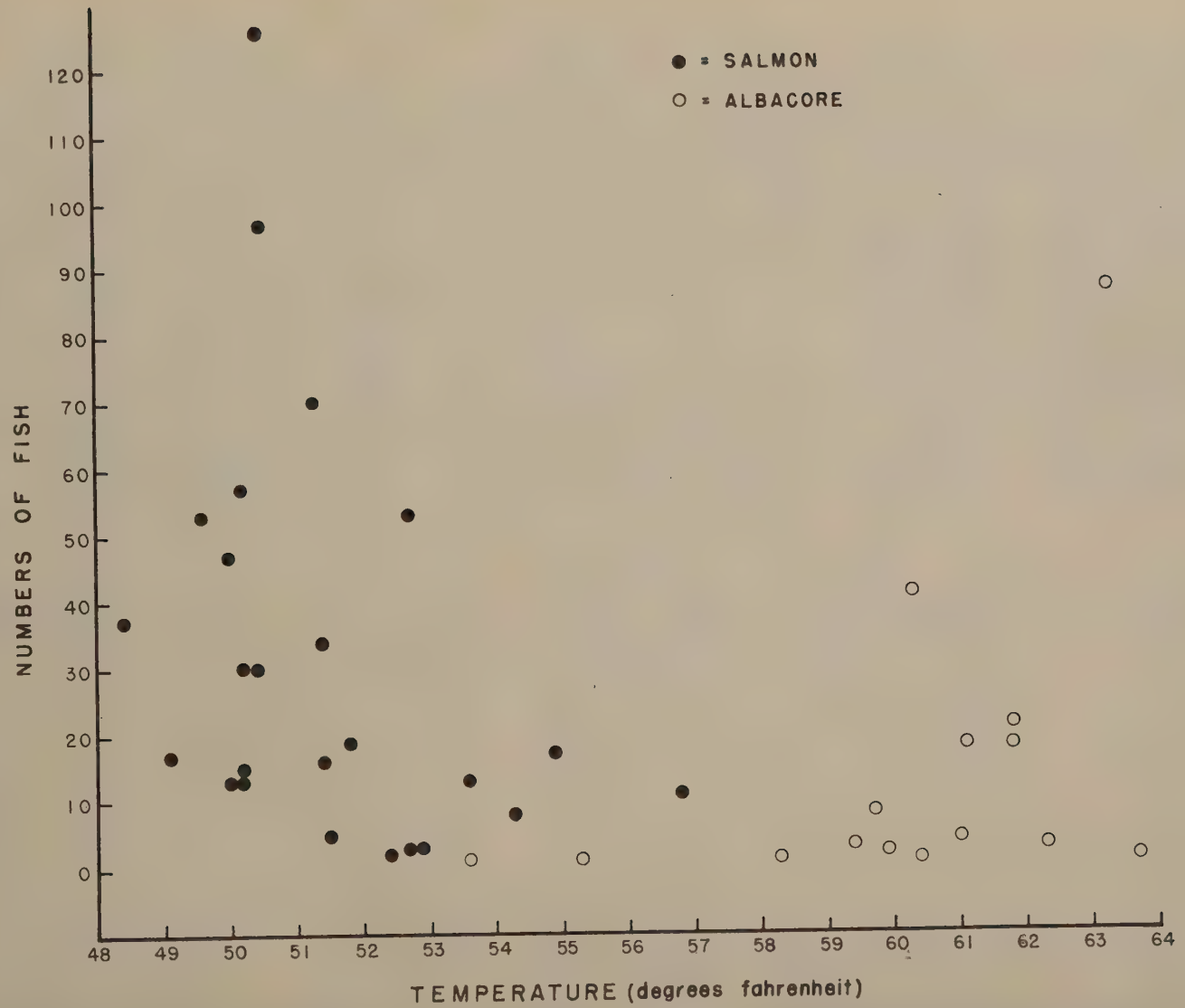


Figure 14.--Relation of surface water temperature to salmon and albacore in the combined Mitkof and Paragon catches.

Table 8.--Composition of salmon gill-net catches (total for 11 sets), Mitkof

Species	Number caught	Percent of total catch
King	3	1.3
Red	122	52.6
Silver 1/	13	5.6
Pink	0	0.0
Chum	94	40.5
Totals	232	100.0

1/ All but one of the 13 silvers were caught station 46 off Cape Flattery.

Table 9.--Composition of salmon gill-net catches (total for 14 sets), Paragon

Species	Number caught	Percent of total catch
King	11	2.0
Red	76	13.6
Silver	1	.2
Pink	0	0.0
Chum	470	84.2
Totals	558	100.0

Table 10.--Catch of salmon in the various size gill nets, Mitkof [1/]

Species of salmon	3¼-inch mesh			4½-inch mesh			5¼-inch mesh		
	Number salmon caught	Number shackles fished	Catch per shackle	Number salmon caught	Number shackles fished	Catch per shackle	Number salmon caught	Number shackles fished	Catch per shackle
King	0	22	0	1	22	.05	2	66	.03
Red	38	22	1.73	39	22	1.77	45	66	.68
Silver	0	22	0	1	22	.05	12	66	.18
Pink	0	22	0	0	22	0	0	66	0
Chum	19	22	.86	32	22	1.45	43	66	.65
Totals	57	22	2.59	73	22	3.32	102	66	1.54

Total catch including all species----------232
Total number of 50-fathom shackles fished.....110
Average catch of salmon per shackle----------2.11

1/ Includes only those sets where salmon were caught. No salmon caught in 2¼-inch mesh nets.

Table 11.--Catch of salmon in the various size gill nets, Paragon 1/

Species of salmon	2¼-inch mesh			3¼-inch mesh			4½-inch mesh			5¼-inch mesh		
	Number salmon caught	Number shackles fished	Catch per shackle	Number salmon caught	Number shackles fished	Catch per shackle	Number salmon caught	Number shackles fished	Catch per shackle	Number salmon caught	Number shackles fished	Catch per shackle
King	0	28	0	1	28	.04	1	28	.04	9	84	0.11
Red	5	28	.18	36	28	1.29	20	28	.71	15	84	.18
Silver	0	28	0	0	28	0	0	28	0	1	84	.01
Pink	0	28	0	0	28	0	0	28	0	0	84	0
Chum	1	28	.04	38	28	1.36	97	28	3.46	334	84	3.98
Totals	6	28	.22	75	28	2.69	118	28	4.21	359	84	4.28

Total salmon catch including all species ----------558
Total number of 50-fathom shackles fished ----------168
Average catch of salmon per shackle ----------3.32

1/ Includes only those sets where salmon were caught.

American coastline by the Mitkof. No salmon were caught at three stations off Cape Bianco, Oregon, and 2 silvers and 1 king were taken at two stations off the mouth of the Columbia River.

LENGTH FREQUENCIES

In figure 16 the fork lengths of 1,052 salmon (all species) caught by the John N. Cobb are shown in frequency distributions according to mesh size. Similarly the length frequencies of all salmon caught by the Mitkof and Paragon are graphed in figures 17 and 18, respectively.

The various mesh sizes were selective for particular size ranges of salmon, but considerable overlapping of the size distribution of salmon occurred in the catches of the different nets. The sizes of fish taken by each mesh were in part dependent on the sizes of fish available to the nets, and the length frequencies which are shown represent size selectivity over a wide range of area and time.

In figure 19 the fork lengths of all salmon caught by the Cobb during the entire season segregated according to species are shown. Likewise, the seasonal length frequencies of each species of salmon taken by the Mitkof and Paragon are given in figures 20 and 21, respectively.

These length-frequency data along with age readings from the scales and with the size and development of the ovaries and testes are being analyzed for a later report. The complete morphological and physiological racial analyses of the ocean catches of the three research vessels will aid in evaluating the extent of intermingling of North American and Asian stocks of salmon.

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1954. Offshore salmon explorations adjacent to the Aleutian Islands, June-July 1953. Dept. of the Interior, Fish and Wildlife Service, Commercial Fisheries Review, Sep. No. 371, vol. 16, no. 5, May 1954, 20 pp., 16 figs., 5 tables.

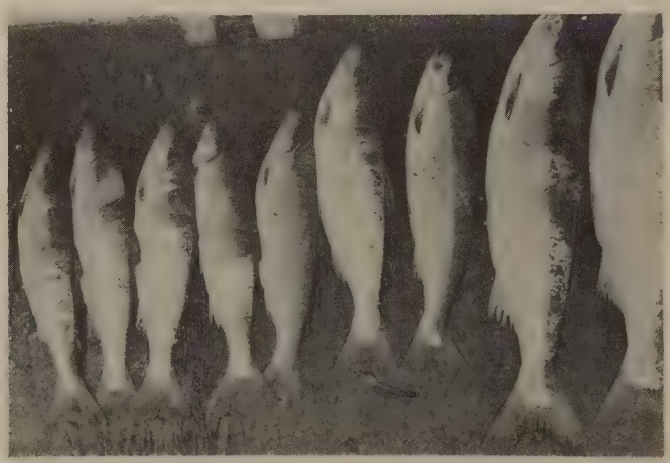

Figure 15.--This group of red salmon illustrates the size range of fish taken in one gill-net set by the John N. Cobb.

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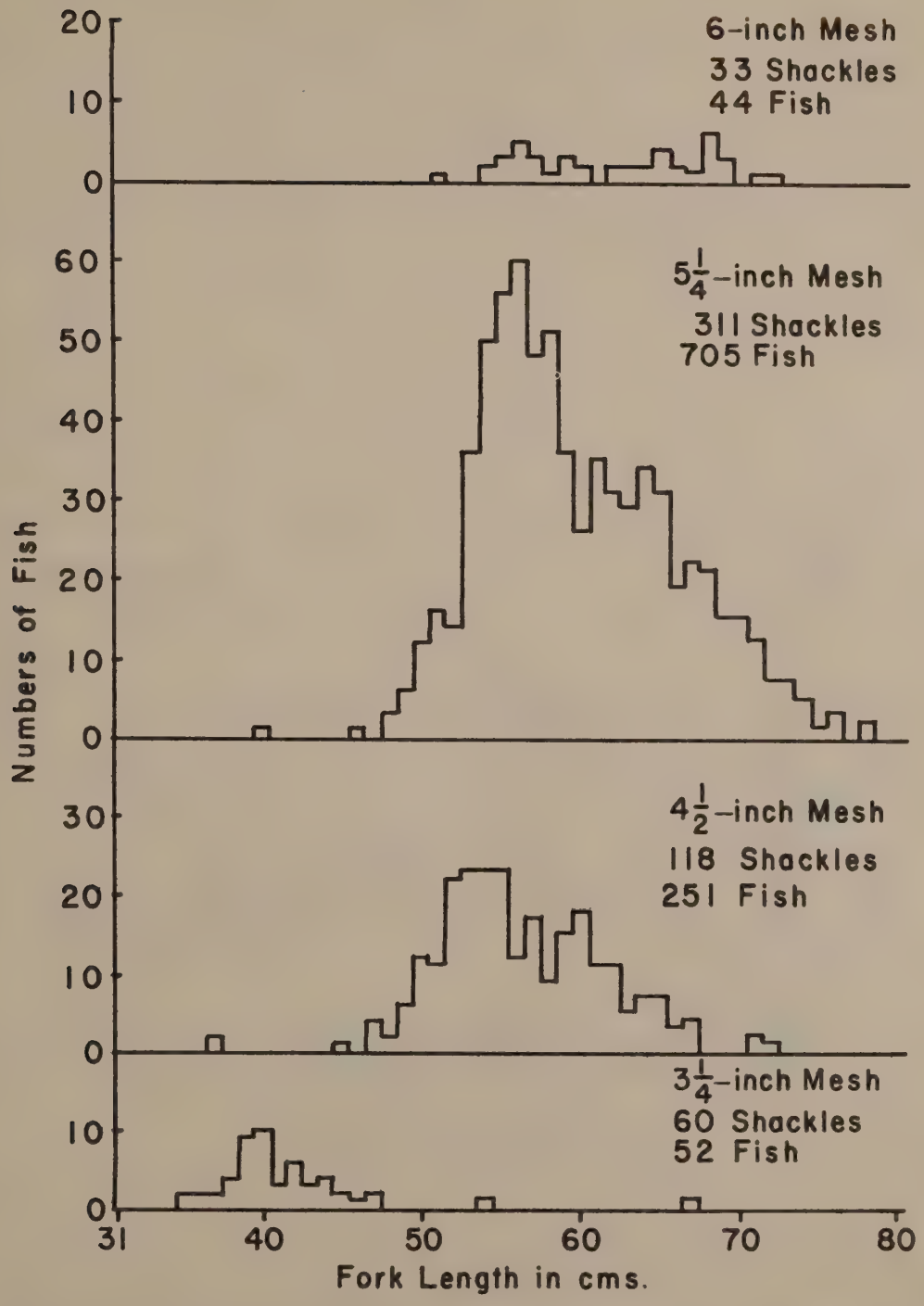

Figure 16.--Length frequency distribution of 1,052 salmon (combined species) taken by each mesh size, John N. Cobb.

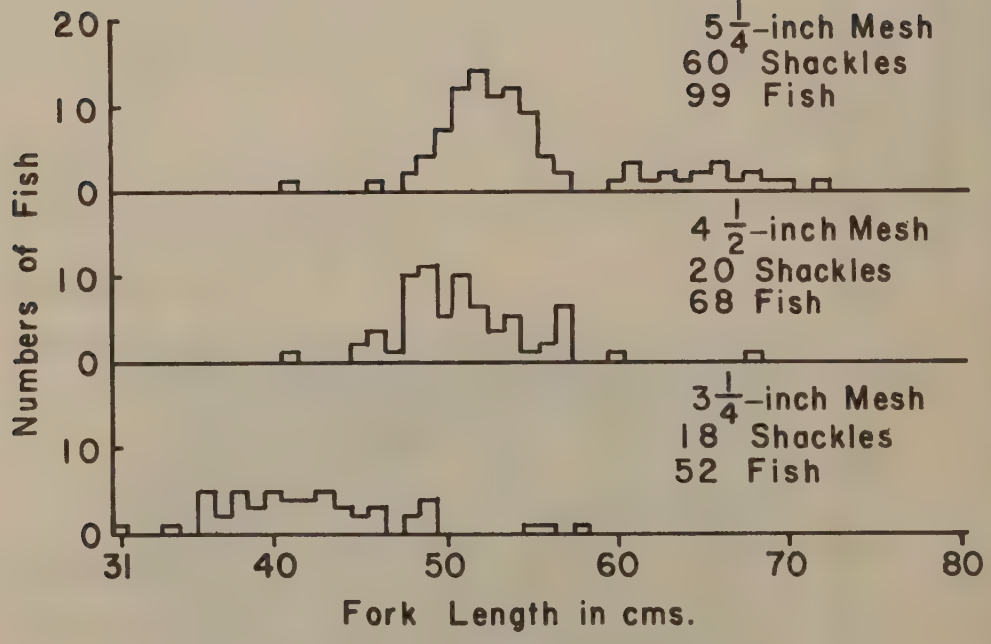

Figure 17.--Length frequency distribution of salmon (combined species) taken by each mesh size, Mitkof.

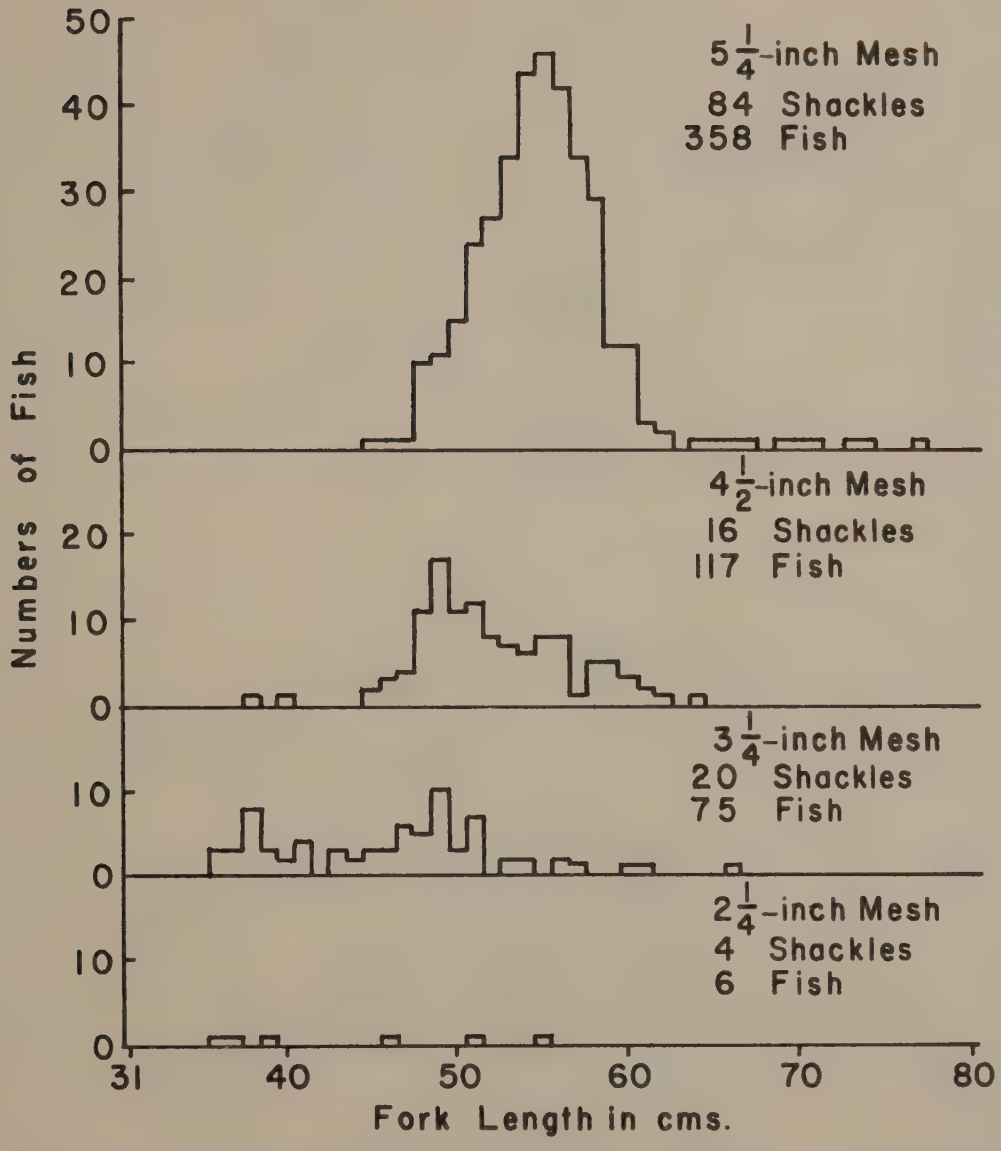

Figure 18.--Length frequency distribution of salmon (combined species) taken by each mesh size, Paragon.

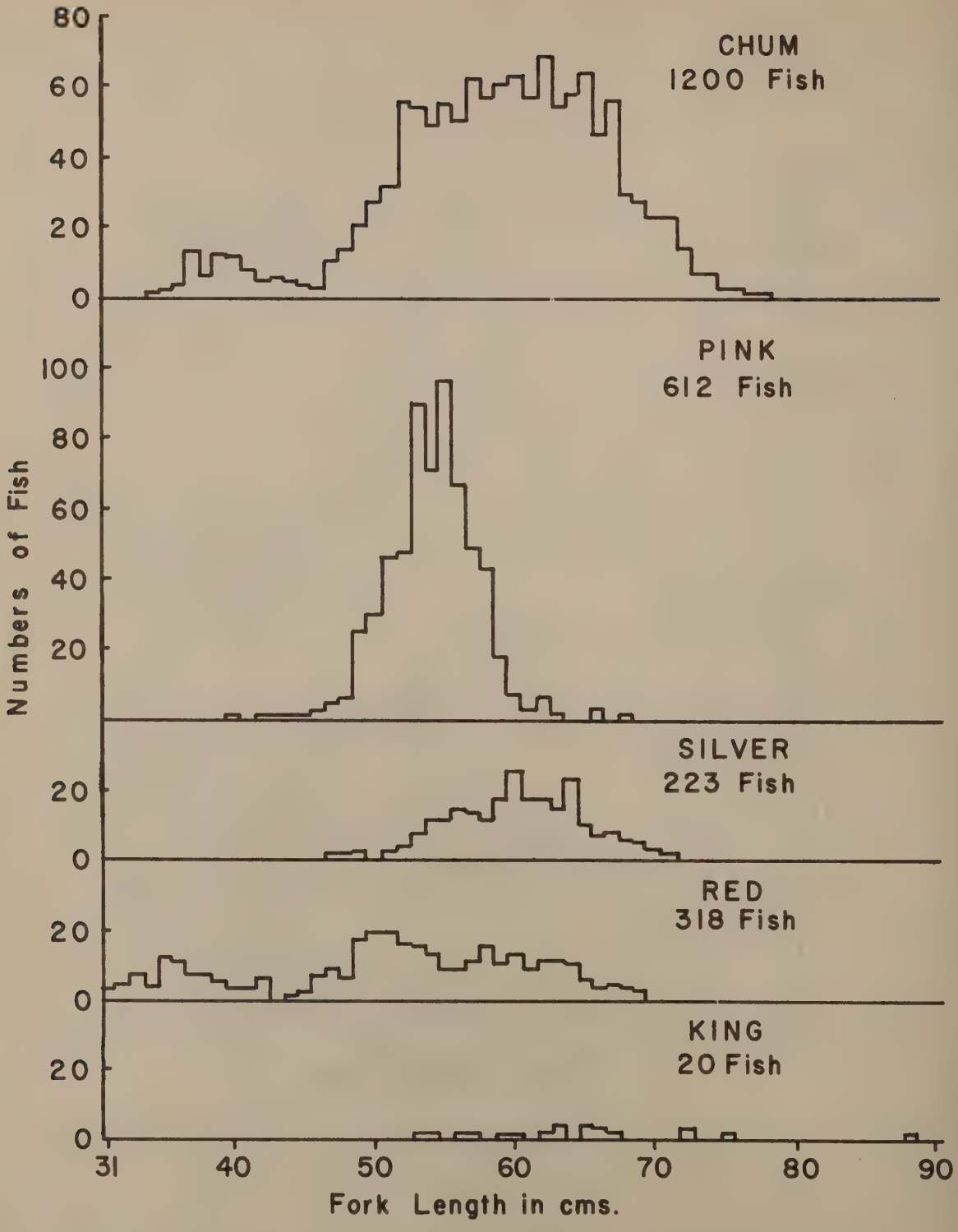

Figure 19.--Length frequency distribution of each species of salmon, John N. Cobb.

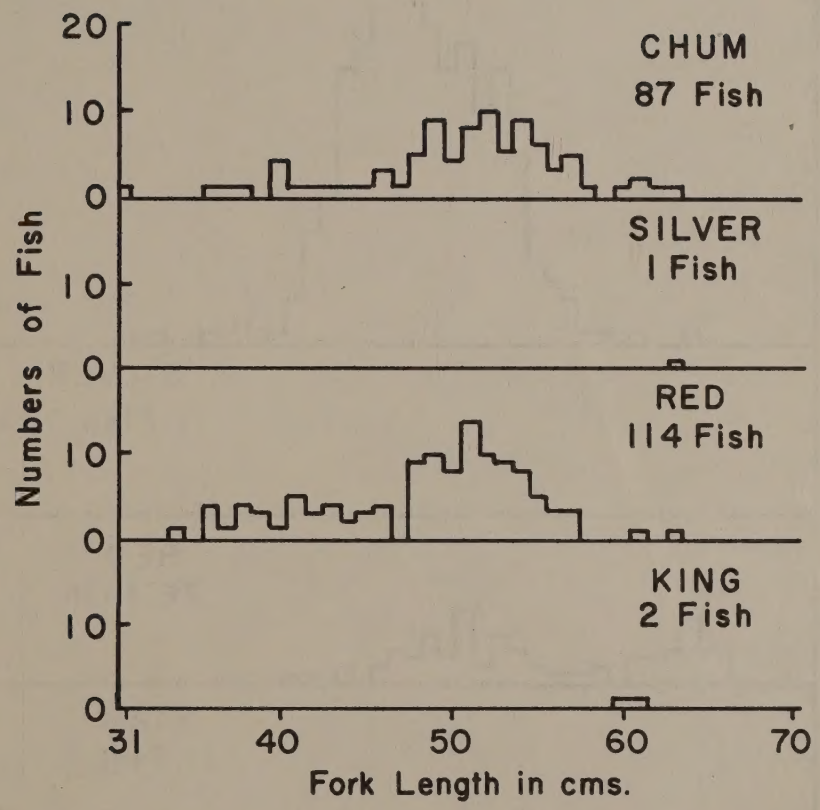

Figure 20.--Length frequency distribution of each species of salmon, Mitkof (catch at station 46, off Cape Flattery, is not included).

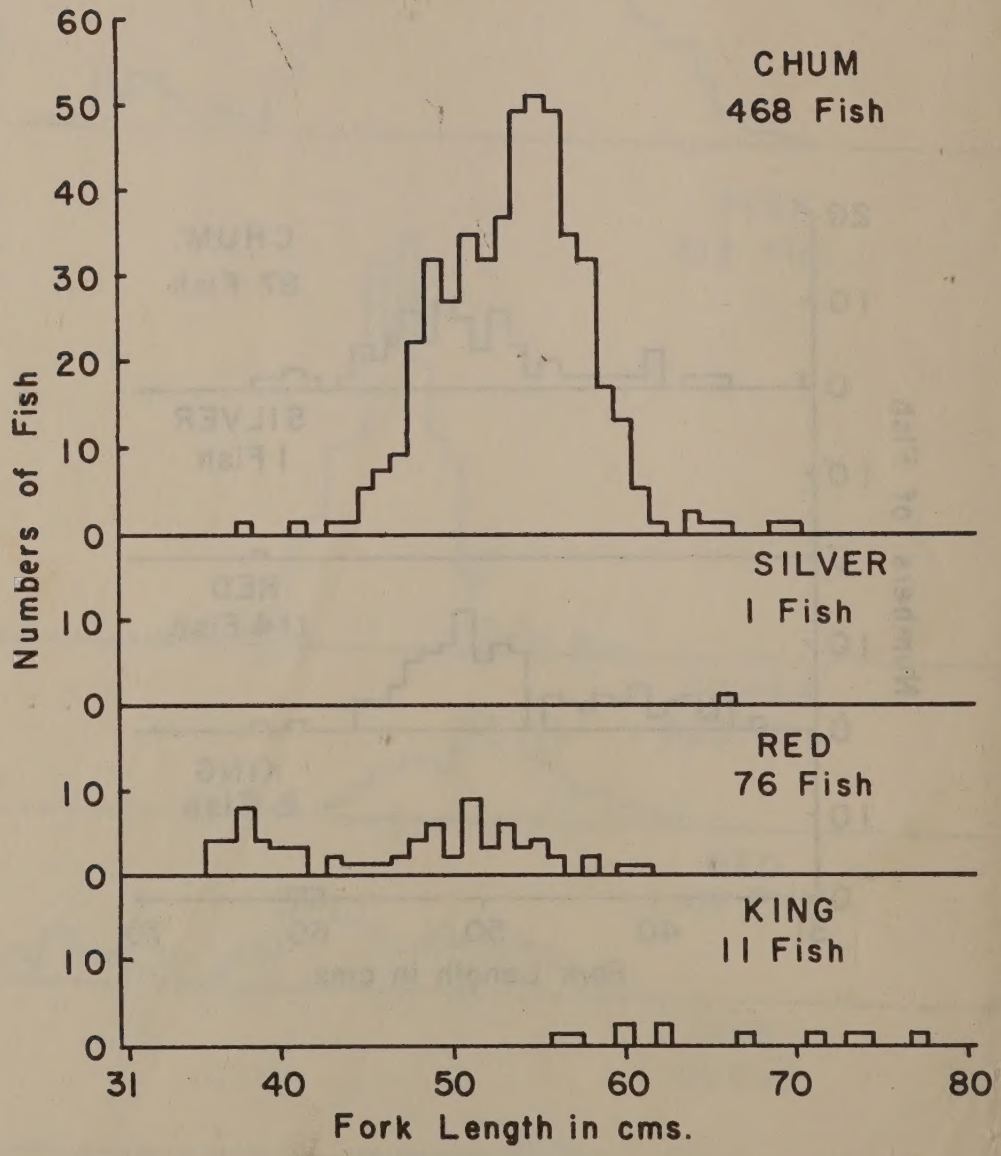

Figure 21.--Length frequency distribution of each species of salmon, Paragon.